

WHAT IS CLAIMED IS:

1. A system for providing measurements of manufactured articles comprising:
  - an article positioning subsystem adapted to place an article in at least one selected position for mass or volume measurements;
  - a signal source of electromagnetic radiation wherein at least a portion of an emitted wavelength spectrum is partially absorbed by the article to produce an absorption-based signal;
  - a sensor apparatus configured to detect the absorption-based signal and produce at least one of an analog output and a digital output based on the signal;
  - a field of view established between the sensor apparatus and at least one selected region of the article; and
  - a processor configured to receive the output of the sensor apparatus and compute a mass or volume of the selected region of the article.
2. The system as set forth in claim 1 wherein the sensor apparatus comprises a single sensor.
3. The system as set forth in claim 2 wherein the sensor apparatus is provided with an optical bandpass filter integrated into an optical path of the sensor apparatus that limits radiation responsiveness to specific wavelength ranges wherein advantageous absorption of the emitted wavelength spectrum takes place.
4. The system as set forth in claim 2 wherein the sensor apparatus comprises a detector element whose natural and limited responsiveness to radiation acts to limit responsiveness to specific wavelength ranges wherein advantageous absorption of the emitted wavelength spectrum takes place.

5. The system as set forth in claim 2 wherein the sensor apparatus is provided with a rotating or oscillating chopper wheel which acts to modulate received signals at a known electrical frequency advantageous to subsequent signal processing operations.

6. The system as set forth in claim 2 wherein a user of the system configures a processor via a user interface with an expected mass and/or volume parameter, and wherein the processor performs a measurement and thresholding analysis on measured data.

7. The system as set forth in claim 6 further including a process correction means wherein corrective adjustments are initiated based on the analysis.

8. The system as set forth in claim 7 wherein the corrective adjustments are performed by one of:  
a manual adjustment;  
a semi-automatic adjustment; and  
an automatic adjustment.

9. The system as set forth in claim 1 wherein the sensor apparatus comprises multiple sensors.

10. The system as set forth in claim 9 wherein individual sensors comprising the multiple sensors each are used to obtain data from a unique portion or an overlapping portion of the article.

11. The system as set forth in claim 9 wherein individual sensors comprising the multiple sensors each are used to obtain data from a different material type contained within the article.

12. The system as set forth in claim 9 wherein the sensor apparatus is provided with at least one optical bandpass filter integrated into an optical path of the sensor apparatus that limits radiation responsiveness to specific wavelength ranges wherein advantageous absorption of the emitted wavelength spectrum takes place.

13. The system as set forth in claim 9 wherein the sensor apparatus comprises at least one detector element whose natural and limited responsiveness to radiation acts to limit responsiveness to specific wavelength ranges wherein advantageous absorption of the emitted wavelength spectrum takes place.

14. The system as set forth in claim 9 wherein the sensor apparatus is provided with at least one chopper wheel which acts to modulate received signal(s) at a known electrical frequency advantageous to subsequent signal processing operations.

15. The system as set forth in claim 1 wherein the sensor apparatus comprises a camera.

16. The system as set forth in claim 15 wherein the sensor apparatus is provided with an optical bandpass filter integrated into an optical path of the sensor apparatus that limits radiation responsiveness to specific wavelength ranges wherein advantageous absorption of the emitted wavelength spectrum takes place.

17. The system as set forth in claim 15 wherein the sensor apparatus comprises a detector array element whose natural and limited responsiveness to radiation acts to limit responsiveness to specific wavelength ranges wherein advantageous absorption of the emitted wavelength spectrum takes place.

18. The system as set forth in claim 15 wherein the sensor apparatus

is provided with a chopper wheel which acts to modulate received signals at a known electrical frequency advantageous to subsequent signal processing operations.

19. The system as set forth in claim 15 wherein a user of the system configures a processor via a user interface with an expected mass and/or volume parameter, and wherein the processor performs a measurement and thresholding analysis on measured data.

20. The system as set forth in claim 19 further including a process correction means wherein corrective adjustments are initiated based on the analysis.

21. The system as set forth in claim 20 wherein the corrective adjustments are performed by one of:

- a manual adjustment;
- a semi-automatic adjustment; and
- an automatic adjustment.

22. The system as set forth in claim 1 wherein the electromagnetic radiation source is provided with an optical bandpass filter integrated into an optical path thereof that limits radiation responsiveness to specific wavelength ranges wherein advantageous absorption of the emitted wavelength spectrum takes place.

23. The system as set forth in claim 22 further comprising a chopper wheel which acts to modulate received signals at a known electrical frequency advantageous to subsequent signal processing operations.

24. The system as set forth in claim 1 wherein the electromagnetic radiation source has a natural and limited emission spectrum that acts to limit

responsiveness to specific wavelength ranges wherein advantageous absorption of the emitted wavelength spectrum takes place.

25. The system as set forth in claim 24 wherein the electromagnetic radiation source is comprised of solid state light emitting diodes.

26. The system as set forth in claim 25 wherein the light emitting diodes are electrically pulsed in order to modulate received signals at a known electrical frequency advantageous to subsequent signal processing operations.

27. The system as set forth in claim 24 wherein the electromagnetic radiation source is provided with a rotating or oscillating chopper wheel which acts to modulate received signals at a known electrical frequency advantageous to subsequent signal processing operations.

28. The system as set forth in claim 1 wherein the field of view is established by an imaging lens.

29. The system as set forth in claim 1 wherein the field of view is established using an aperture mechanism.

30. The system as set forth in claim 29 wherein the aperture mechanism is implemented as an aperture plate localized to the sensor apparatus.

31. The system as set forth in claim 29 wherein the aperture mechanism is implemented as an aperture plate localized to the electromagnetic radiation source.

32. The system as set forth in claim 1 wherein the field of view is established using multiple aperture plates.

33. The system as set forth in claim 32 wherein the aperture plates are localized to the sensor apparatus.

34. The system as set forth in claim 32 wherein the aperture plates are localized to the electromagnetic radiation source.

35. The system as set forth in claim 1 wherein the field of view is established using a configurable aperture mechanism.

36. The system as set forth in claim 35 wherein the configurable aperture mechanism is an electronically addressable spatial light modulator.

37. The system as set forth in claim 35 wherein the configurable aperture mechanism is a mechanically adjustable aperture.

38. The system as set forth in claim 35 wherein the mechanically adjustable aperture is servo-motor driven.

39. The system as set forth in claim 1 wherein the article positioning system is an article support subsystem for off-line mass and/or volume measurements.

40. The system as set forth in claim 1 wherein a user of the system configures a processor via a user interface with an expected mass and/or volume parameter, and wherein the processor performs a measurement and thresholding analysis on measured data.

41. The system as set forth in claim 40 wherein the article positioning system is an article transport subsystem for on-line mass and/or volume measurements.

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42. The system as set forth in claim 41 further including:  
a part detect subsystem configured to detect articles placed for mass or volume measurements by the article transport subsystem;  
a part tracking subsystem configured to track article positions in the article transport subsystem; and  
a part reject/marketing subsystem configured to selectively remove or mark articles rejected based on the volumetric measurement verification.

43. The system as set forth in claim 40 further including a process correction means wherein corrective adjustments are initiated based on the analysis.

44. The system as set forth in claim 43 wherein the corrective adjustments are performed by one of:  
a manual adjustment;  
a semi-automatic adjustment; and  
an automatic adjustment.

45. The system as set forth in claim 1 wherein a user of the system configures a processor via a user interface with an expected mass and/or volume parameter, and wherein the processor performs a measurement and thresholding analysis on measured data.

46. A method for providing measurements on articles of manufacture in a system using a radiation source and a sensor, the method comprising the steps of:

generating a first signal based on radiation emitted from the radiation source and detected by the sensor;  
positioning an article in a field of view established between the radiation source and the sensor;  
generating a second signal based on radiation emitted from the

radiation source, partially absorbed by the article, the unabsorbed portion of the radiation being detected by the sensor; and

analyzing the first signal and the second signal to obtain one of a mass and volume measurement of the portion of the article.

47. The method as set forth in claim 46 further comprising the process of determining whether the article is acceptable based measured mass/or volume value and user established limits.

48. The method as set forth in claim 47 further comprising performing adjustments to a manufacturing process for the article based on the analyzing and the determining.

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